

Nutritional Biochemistry of Spaceflight











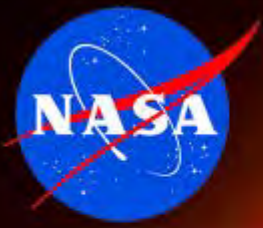








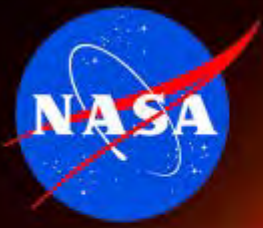




Functions of Nutrition



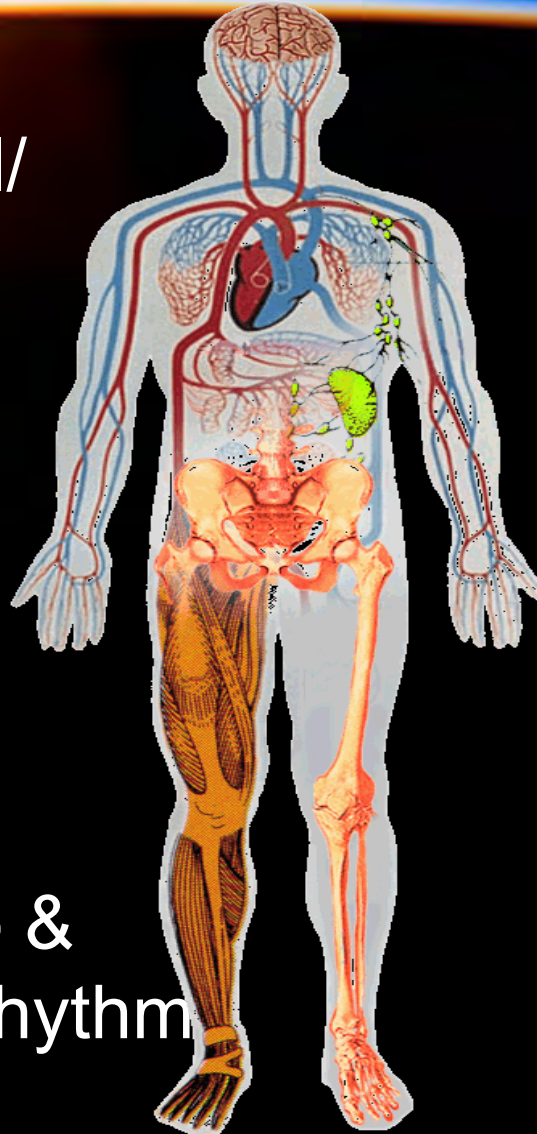
- Meet Energy / Nutrient Requirements
 - Psychosocial Aspects
 - Countermeasure



Adaptation to Weightlessness

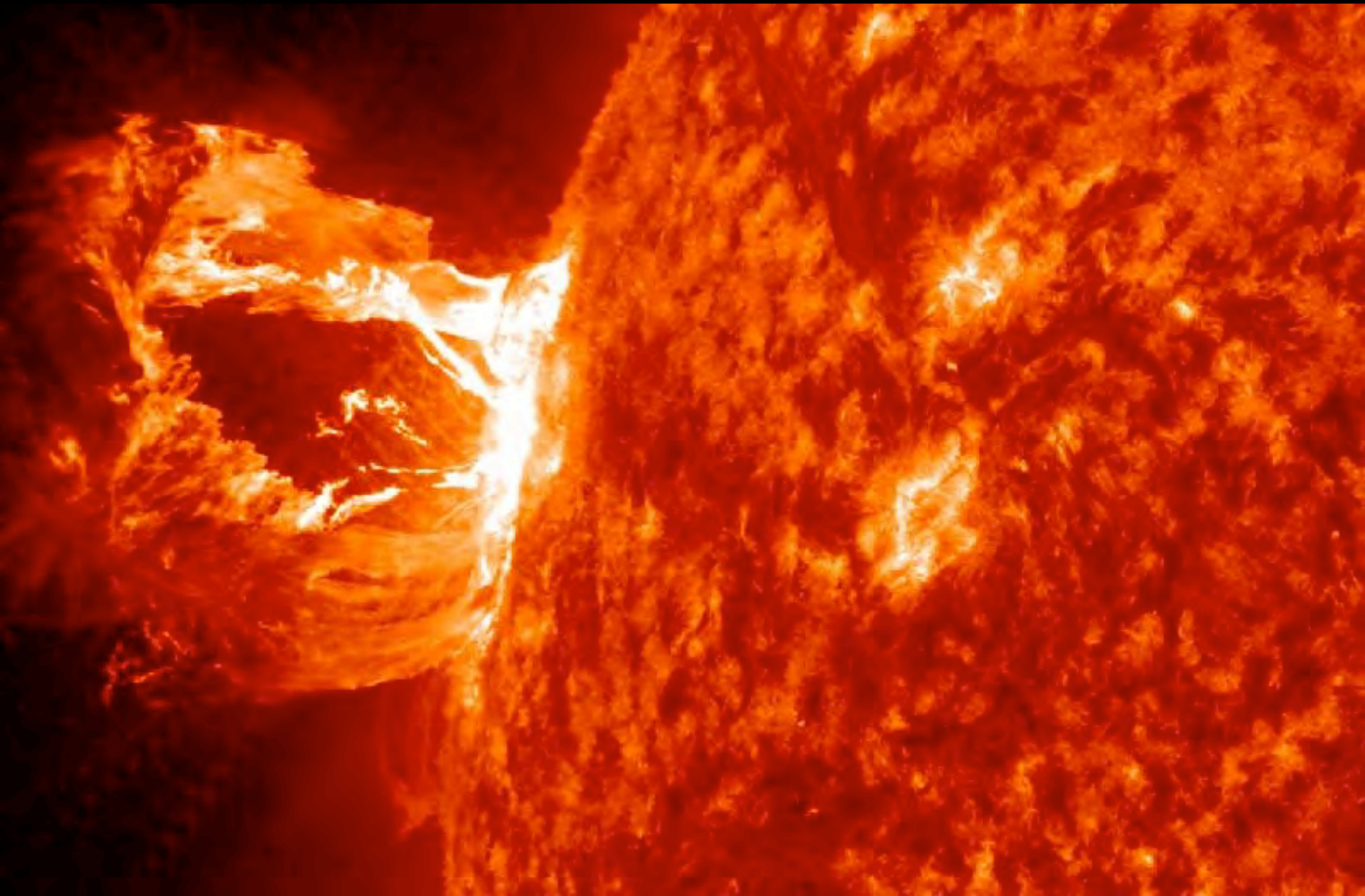


- Psychological/
Behavioral/
Performance
- Taste & odor
- Neurosensory
- Sleep &
circadian rhythm



- Muscle
- Bone
- Fluid shifts,
hematological
- Cardiovascular
- Gastrointestinal
- Environmental

Radiation



Extravehicular Activity



Early Space Food



ISS Foods



Food Preparation in Space



ISS Fresh Food





Operations Research



Nutrition Experiment Study Design

Schedule

- 3 pre-flight blood/urine collections (L-180, L-45, L-10)
- 5 in-flight blood/urine collections (FD15, FD30, FD60, FD120, FD180)
- 2 post-flight blood/urine collections (R+0, R+30)

Samples are analyzed for a battery of tests

- Vitamins, Minerals, Proteins, Hormones/General Chemistry
- Bone Markers, Renal Stone Risk











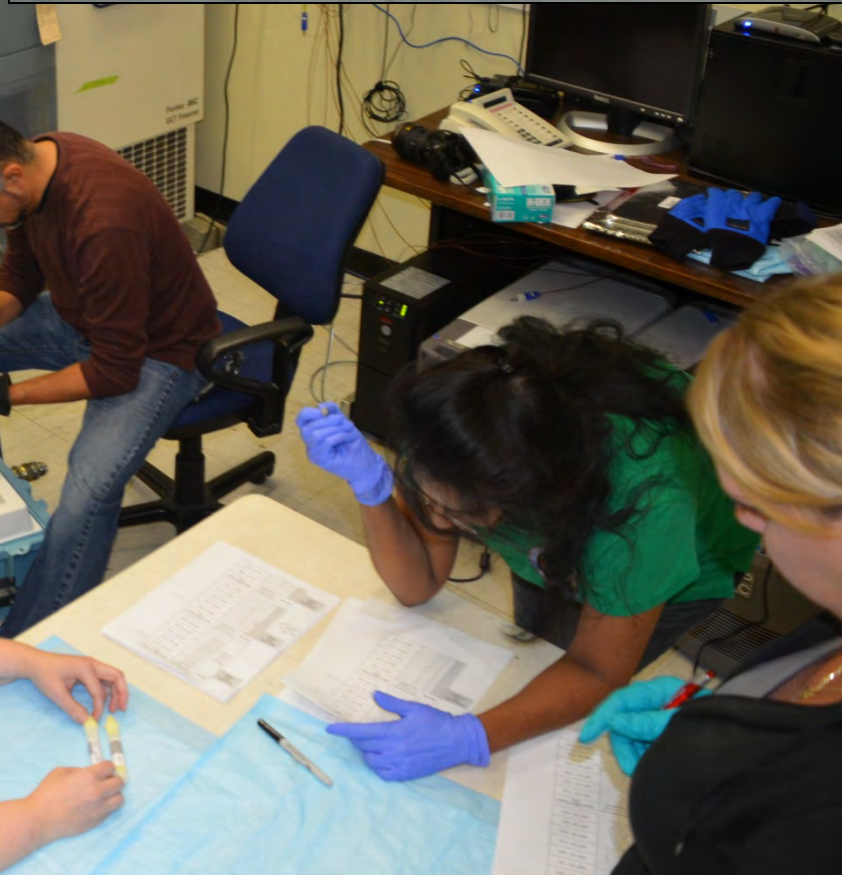
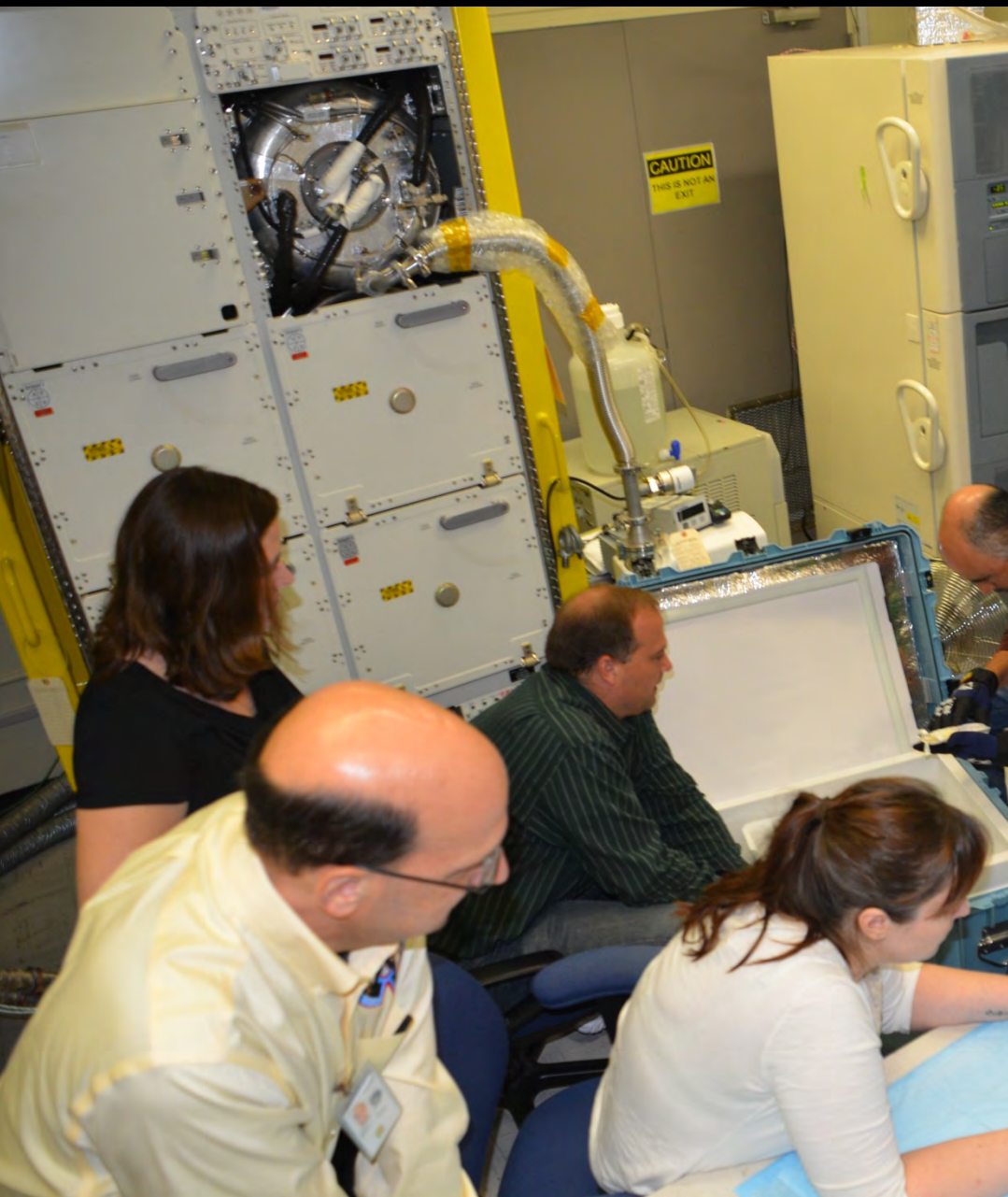


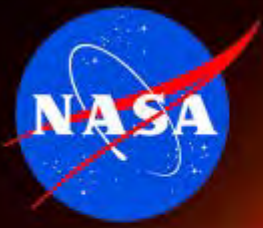












Energy Intake



Energy Intake
(% WHO Requirement)

Apollo

Skylab

Shuttle

E1-4

E5-16

E17-29

- Inadequate food intake will compromise crew health and performance
- Intake of all nutrients is dependent on the adequacy of energy intake

SLAMMD

- Space linear acceleration mass measurement device
 - Linear acceleration
 - Newton's 2nd Law of Motion ($F = ma$)





Body Mass



Body mass
(% change from preflight)

Pre

FD1-30

FD31-60

FD61-90

FD91-120

FD121-150

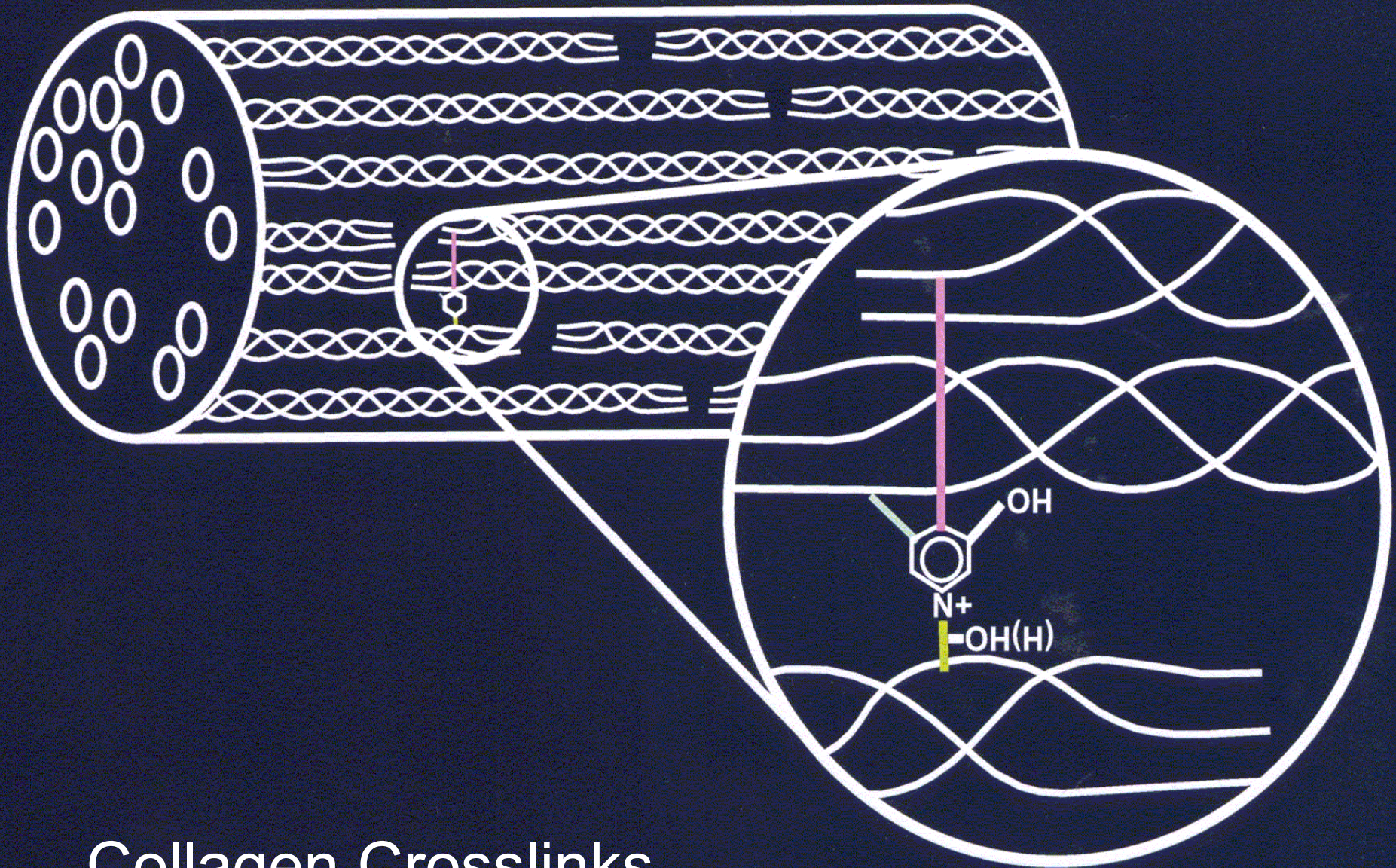
FD151-190

R+0

R+30

Energy intake
(% WHO recommendation)

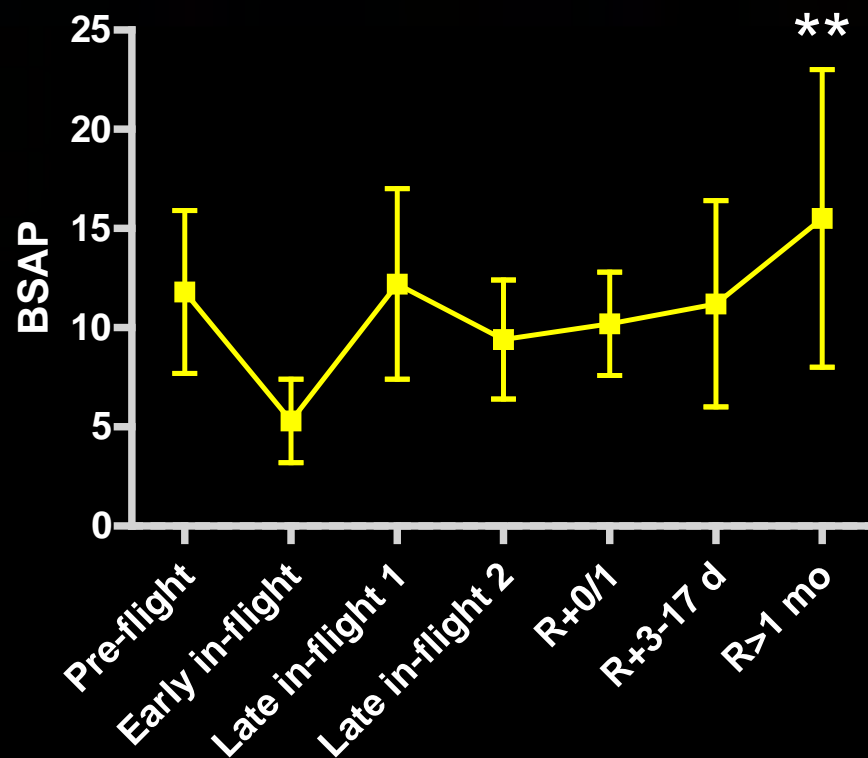
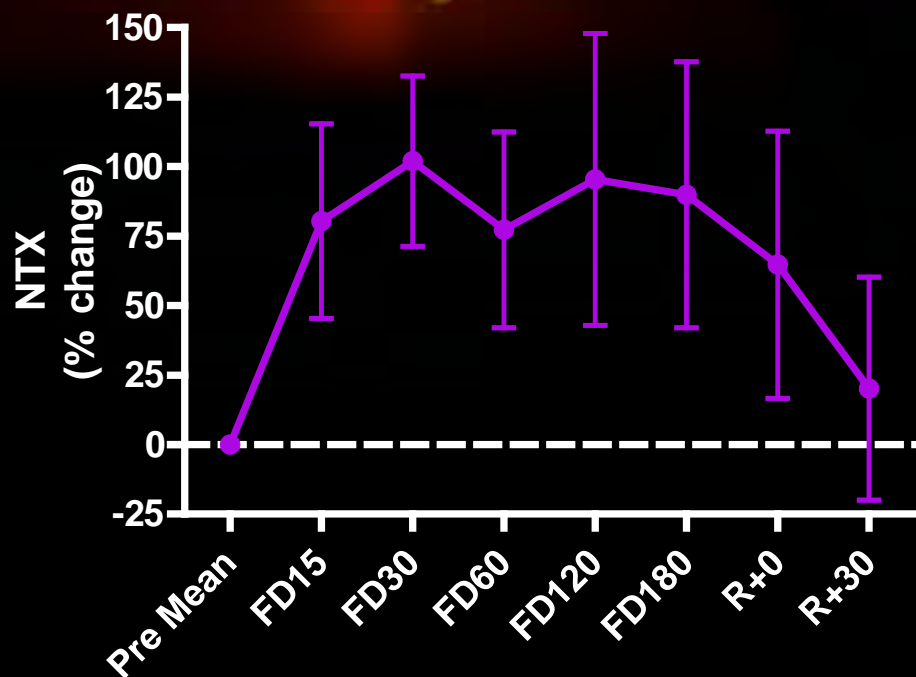
Urinary Biomarkers



Collagen Crosslinks

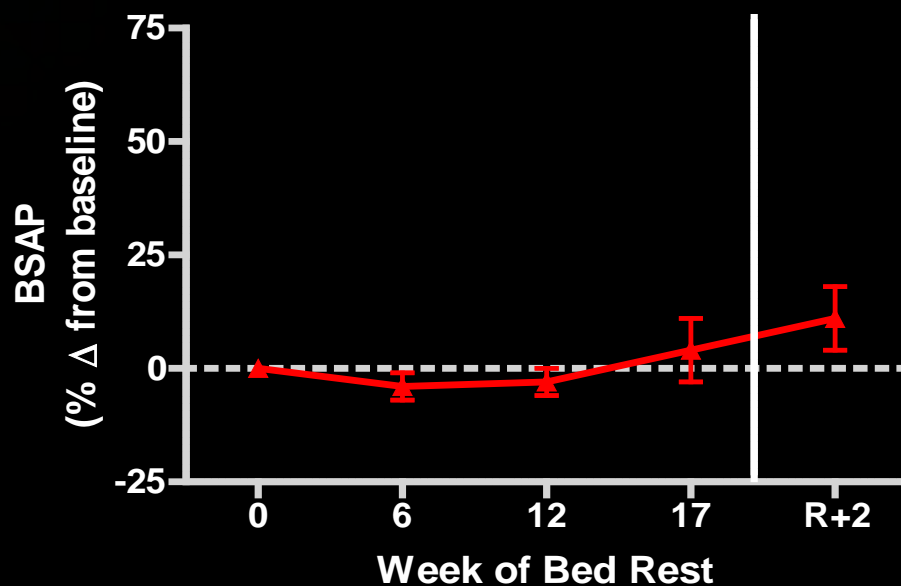
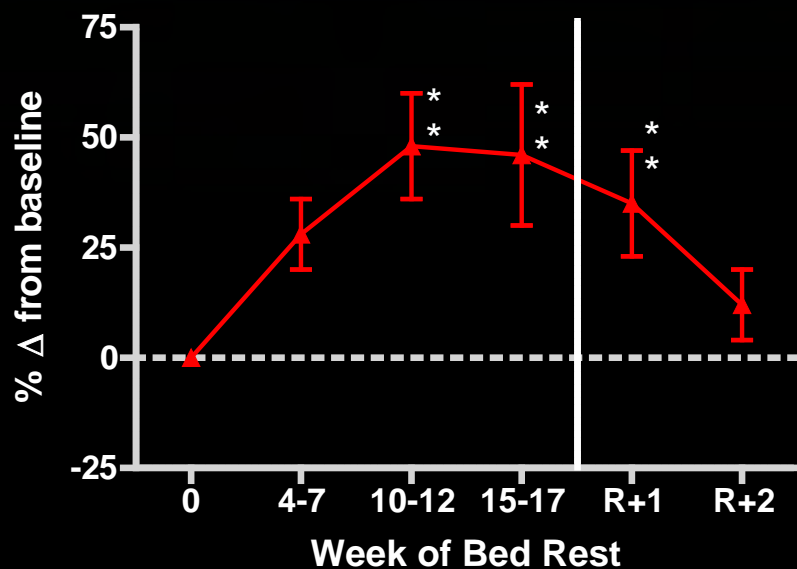


Bone Resorption/Formation





Bone Formation/Resorption





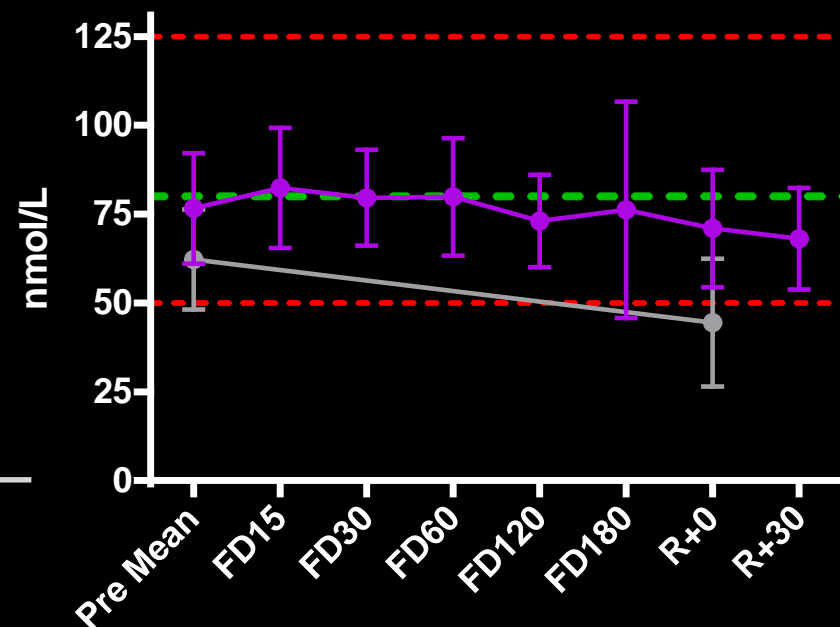
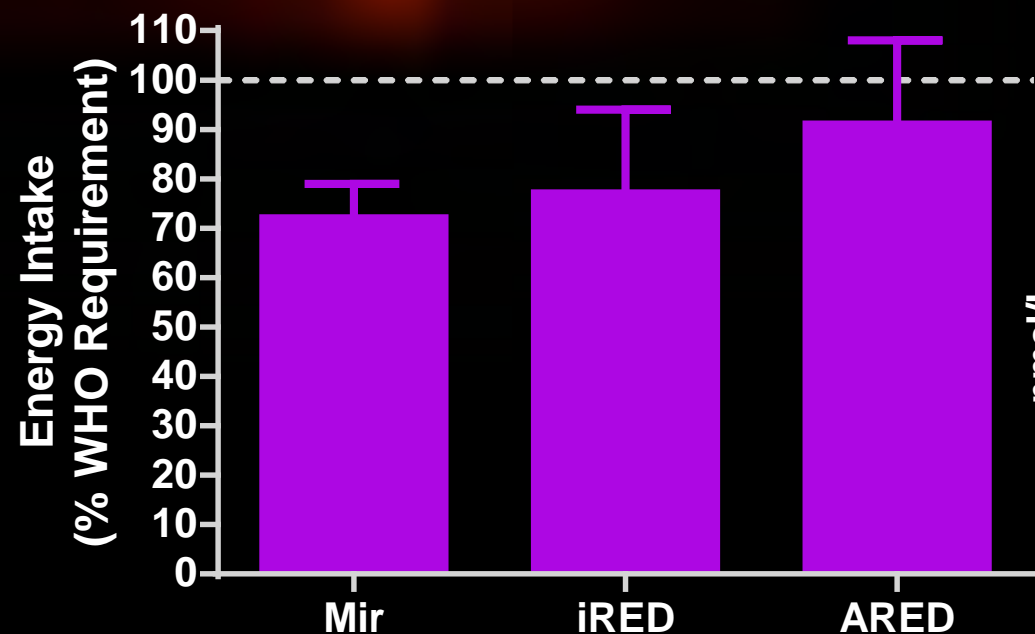
ired



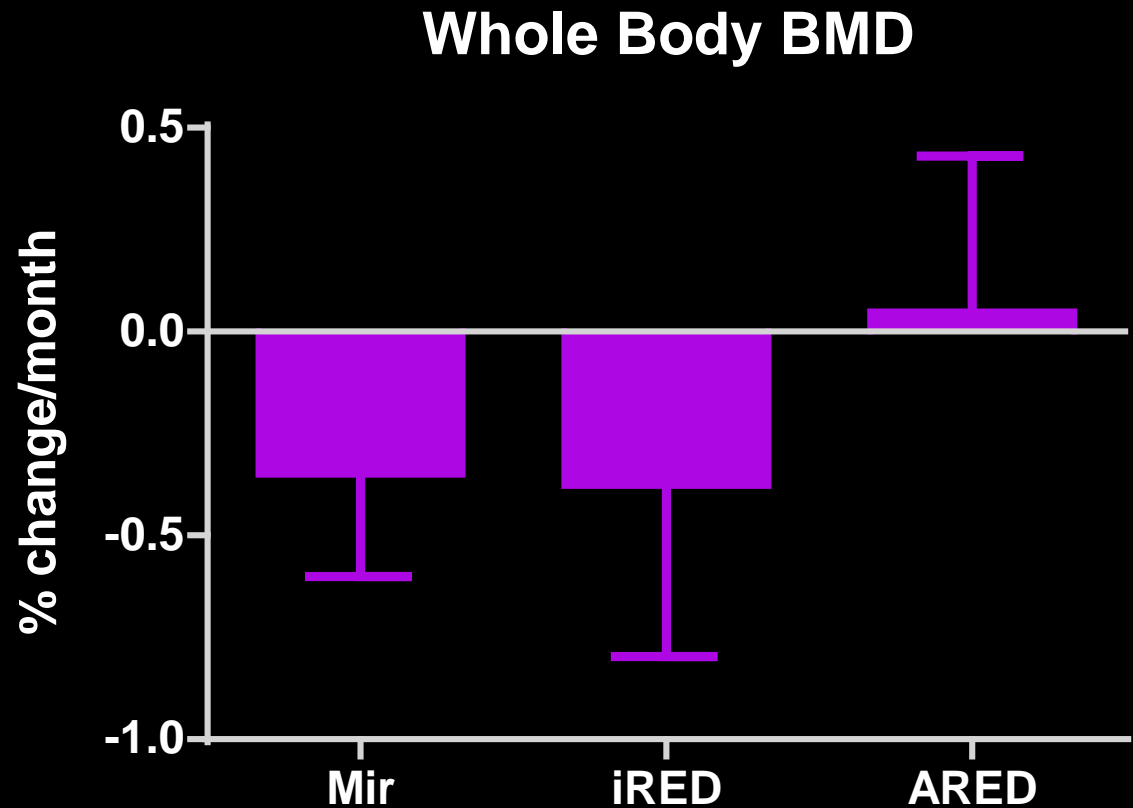
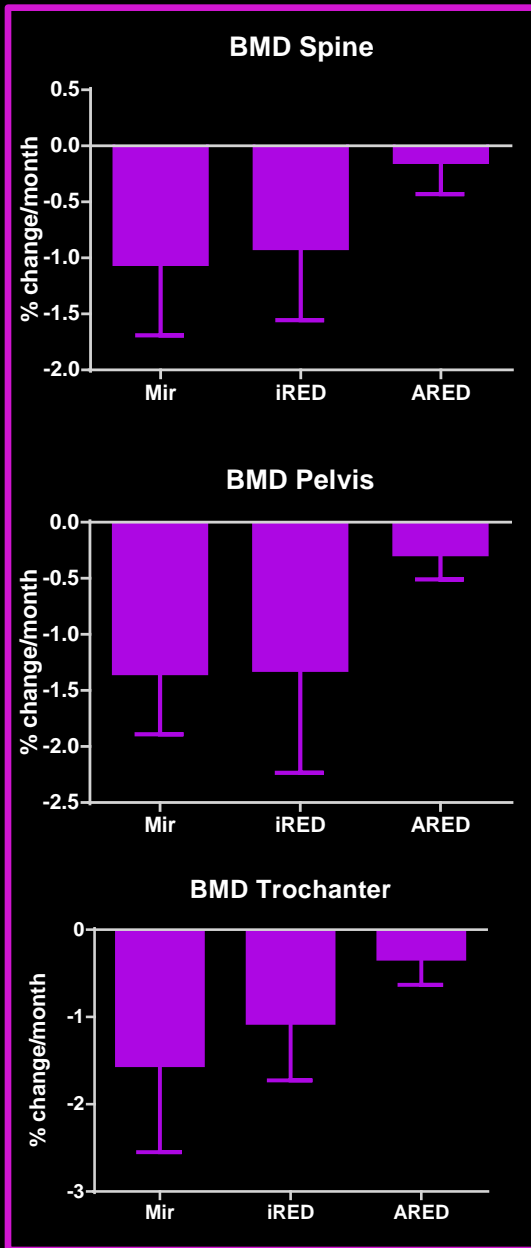
ared



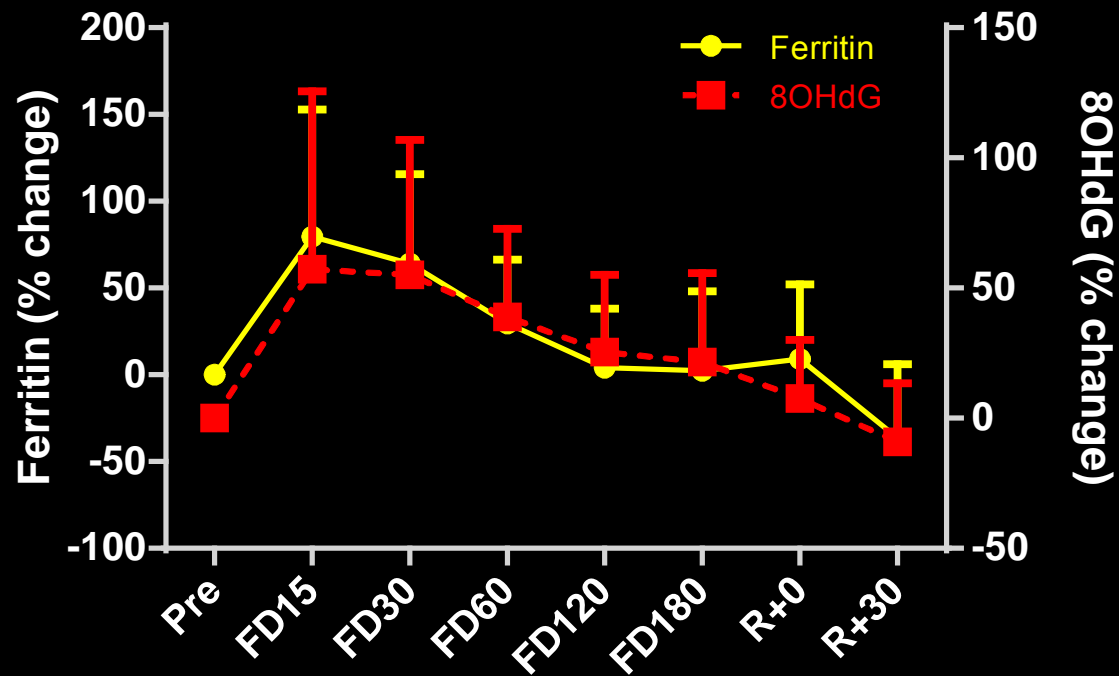
Energy Intake/Vitamin D



Bone Mineral Density

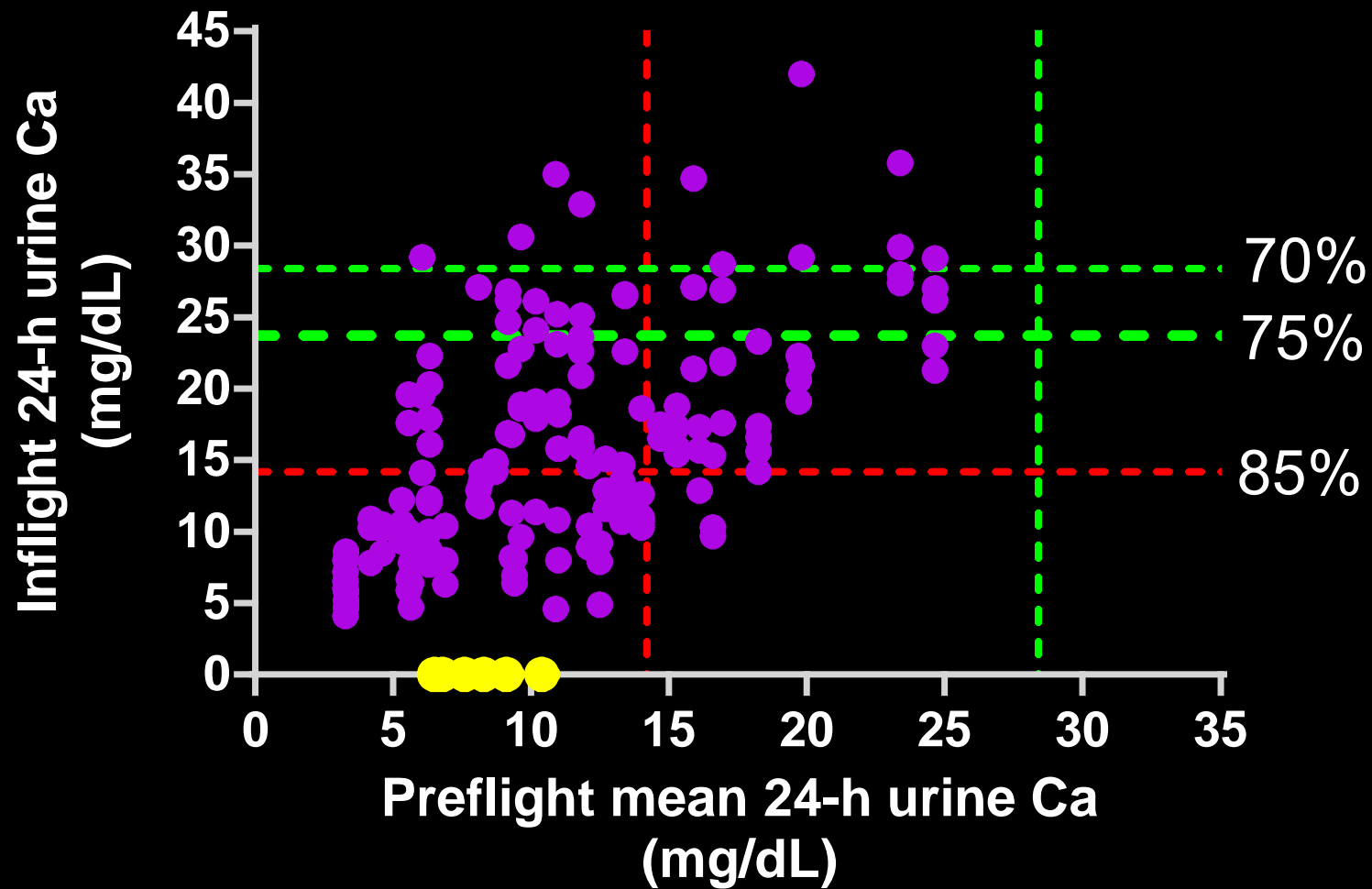


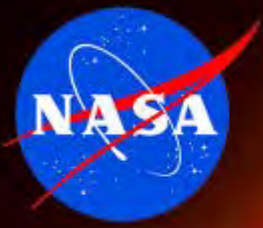
Iron, Oxidative Stress, and Bone











Forward Work



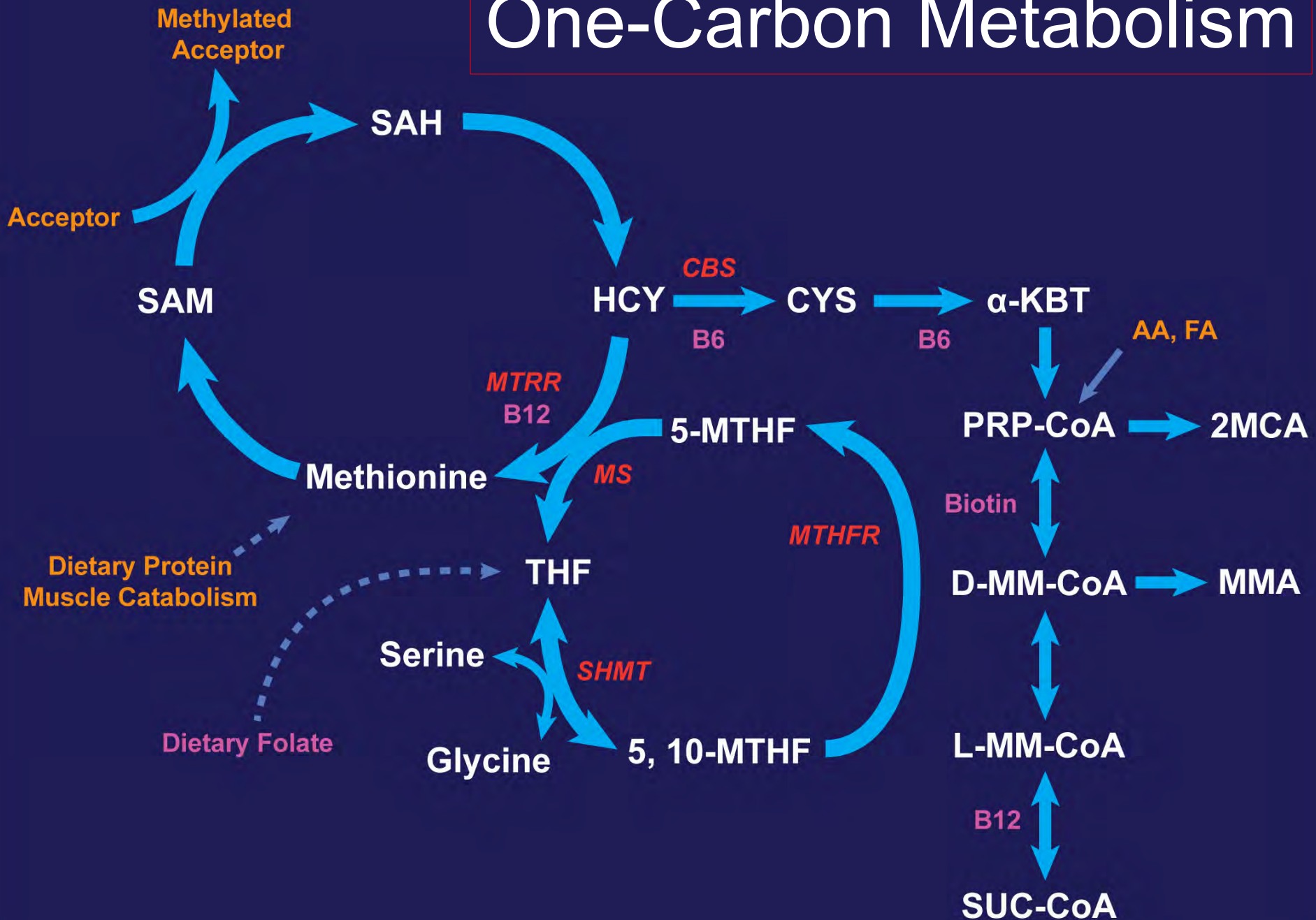
Bone Strength?
Fracture risk?

↑ resorption
↑ formation

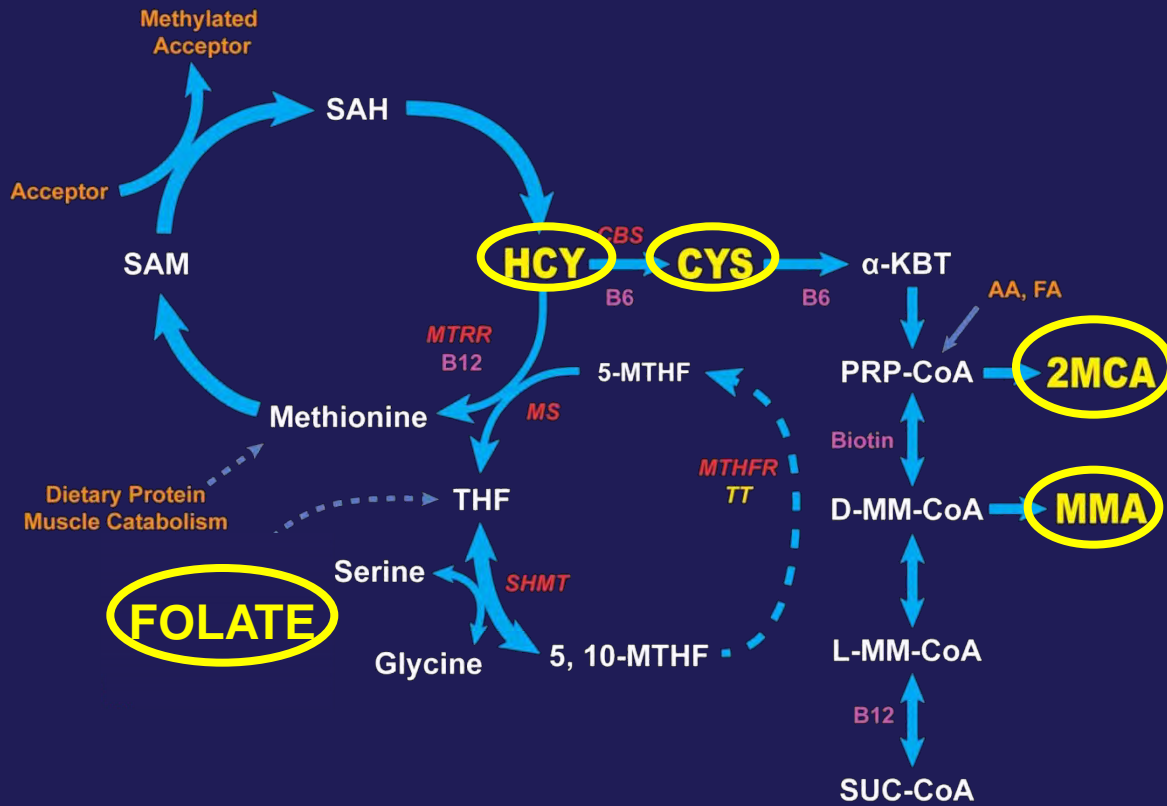
Optimization
Exercise
Diet



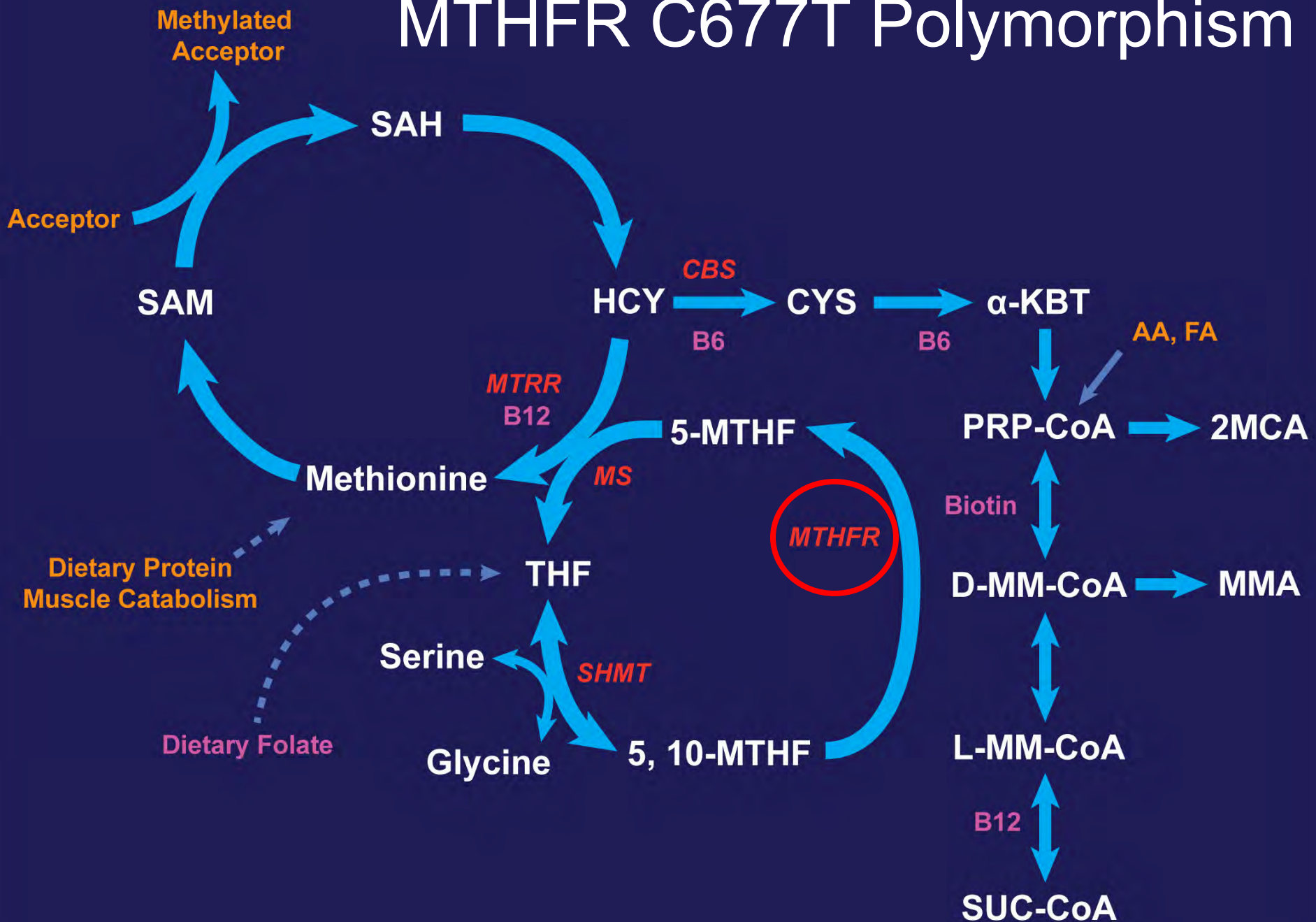
One-Carbon Metabolism



Homocysteine, $\mu\text{mol/L}$



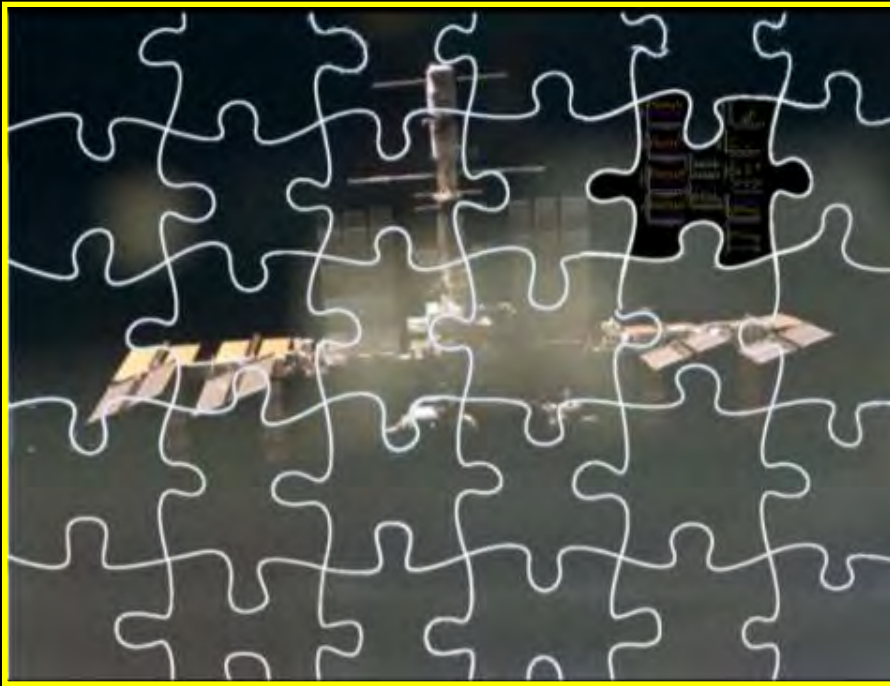
MTHFR C677T Polymorphism



MTHFR C677T Polymorphism

Everybody has 2 sets of blueprints (mom and dad), resulting in four possibilities of this polymorphism.



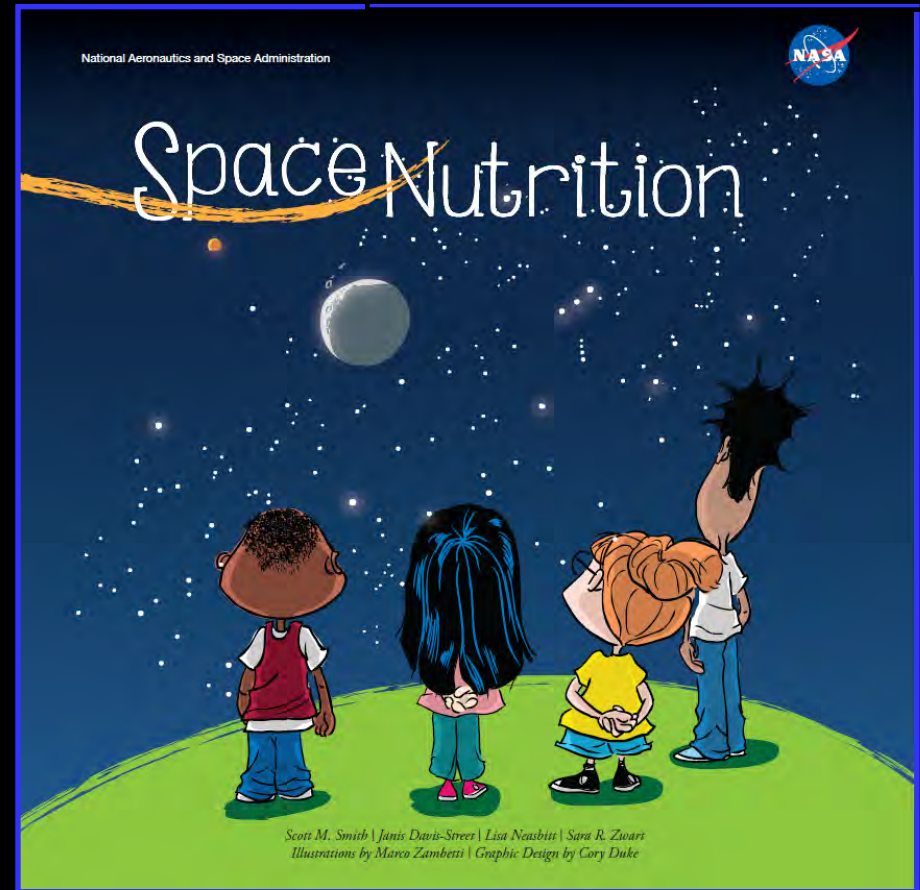
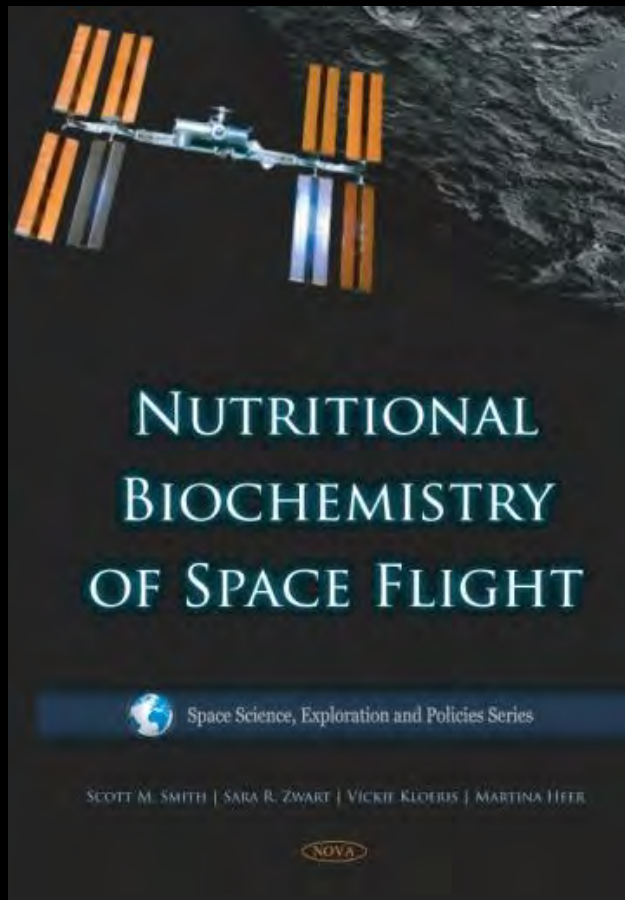


Earth Benefits



- **Research**
- **Countermeasures**
- **Technology**
- **Education/Outreach**

Now available on iTunes!



<http://go.nasa.gov/QS1KW1>

